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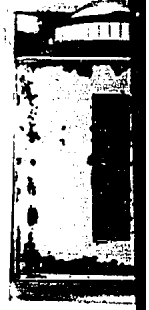
Sanitized Copy Approved for Release 2011/07/12 : CIA-RDP80-00809A000700240022-9



USSR WORK ON PROBLEMS OF INDUSTRIAL SANITARY CHEMISTRY

[Numbers in parentheses refer to appended sources.]

Conference on Industrial Sanitary Chemistry

The Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR held an expanded conference on industrial sanitary chemistry 19-20 October 1954. Three hundred persons participated in the conference. Forty-three reports were presented and ten addresses were given.

The conference demonstrated that industrial sanitary chemistry had been enriched by new methods of investigation during recent years. The Kiev Institute of Labor Hygiene and Occupational Diseases (V. P. Vendt) developed simple equipment for spectrophotometric measurements in the ultraviolet and infrared regions of the spectrum. Investigations on the subject (M. S. Bykhovskaya) demonstrated that the spectrographic method of analysis is preferable to the chemical methods in a number of cases, e.g., in the determinations of beryllium, thallium, and zinc in the presence of copper. For some substances, (lead) this method is less sensitive than chemical analysis. Chromatographic methods for the determination in the air of a number of organic nitro compounds, the separate determination of manganese compounds of different valences, the determination of lead in the presence of iron and barium, etc, are being introduced more widely into practical use (I. B. Kogan, M. S. Bykhovskaya). Among physicochemical methods of analysis, the chromatographic method is currently acquiring increasing significance.

The Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR, is conducting work on the application of various chromatographic methods for the separation of mixtures (L. S. Chemodanova).

The optimal conditions for the determination of a number of toxic substances with the application of the luminescence methods of analysis have been found. This work applies to determinations carried out on oil fogs, esters of phthalic acid, phthalic anhydride, beryllium, etc.

The development and use of rapid methods to determine the presence of various harmful substances in the air of industrial establishments is of practical importance. Of value in this respect is work done by the Leningrad Institute of Labor Protection (I. G. Vorokhobin, T. M. Kozlyayeva, Ye. D. Filyanskaya) on methods of linear colorimetry [methods based on measurement of the distance along which the filling of a column that contains an indicator has reacted after the mixture being tested has been passed through the column] and by the Leningrad Institute of Labor Hygiene and Occupational Diseases (Ye. A. Peregud) with the application of dry standard scales.

For a sanitary-hygienic evaluation of working conditions, the possibility of continuously recording impurities of a toxic nature contained in the air is of great importance. Of particular interest from this standpoint is work by the Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR, in collaboration with the Central Scientific Research Institute of the Tin Industry (O. D. Khalizova, Ye. A. Batmanovskiy) on automatic recorders which signal the presence of excessive concentrations of arsine, chlorine, hydrogen sulfide, ozone, and mercury in the air. The apparatus developed by the Leningrad Institute of Labor Protection (M. A. Petrova, and E. G. Verebyanko) to determine excess concentrations of ethyl lead gasoline which constitute a danger of explosions, is also of interest in this connection.

Investigations on highly dispersed aerosols which form in the air of industrial establishments and the use of the electron microscope for this type of investigation (Ye. V. Gernet), are of great importance.

The theoretical background on the basis of which new organic reagents are used for the determination of some elements, increases the possibility that colorimetric methods may be used for the determination of these elements (V. I. Kuznetsov).

In addition to work on finding new color reaction for the determination of individual substances, methods of group analysis, elemental analysis, and functional analysis are of great significance.

An important task facing hygienists is elimination of silicosis as an occupational disease. The problem of silicosis has induced chemists to search for new methods of determining free silicon dioxide in the presence of silicates. As a result of the discussions which took place at the conference, it appears that the method involving the use of pyrophosphoric acid is at present the most reliable and hence to be recommended for practical use. Among other methods of determining free silicon dioxide which have been discussed, the thermal method is the best.

The determination of organosilicon monomers, i.e., alkylchlorosilanes and arylchlorosilanes is also of great interest, because these monomers are used widely in technology for the synthesis of high-molecular organosilicon compounds and for a number of other purposes. This work is of importance because of the toxicity of the organosilanes in question. The Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR, has developed for the first time a quantitative colorimetric method to determine the vapors of some alkylchlorosilanes and arylchlorosilanes when these substances are present in the air in the form of undecomposed molecules.

The development of sensitive methods for the determination of toxic substances in materials of biological origin is of great importance for the pathology of occupational diseases. From this standpoint, the following work is of importance: procedures for the determination of arsenic, discussed in a paper by A. N. Krylov of the Moscow Institute of Forensic Medicine; work on methods for the determination of mercury, reported on by P. A. Pavlovskaya of the Moscow Pharmaceutical Institute; and procedures for the determination of manganese in biological substrates, discussed in a paper by P. P. Protopopov of the Institute of Labor Hygiene and Occupational Diseases. The report by E. B. Kurlyandskaya (Institute of Labor Hygiene and Occupational Diseases, Academy of Medical Sciences USSR), on the possibility of using radioactive isotopes in industrial technology and industrial sanitary chemistry was of interest. Application of these methods will undoubtedly enhance the possibilities of detecting ultramicroquantities of toxic substances.

The great number of papers, presented at the meeting, which dealt with methods for the determination of various toxic substances indicates that industrial sanitary chemistry is forging ahead and advancing on a wide scale.

Notwithstanding a number of achievements and a great amount of successful work, the conference found that there are some shortcomings in scientific research work and in the work of practical laboratories. One of these drawbacks is the hiatus in the development of more perfect methods of air sampling for the purpose of determining harmful gases, vapors, and aerosols contained in the air. The resolution passed by the conference indicates the ways along which industrial sanitary chemistry must develop. (1)

General Background of the Application of Analytical Techniques in Industrial Sanitary Chemistry

Development of scientific methods of labor protection originated in the USSR on 17 May 1918, with the signing of the decree which founded the State Labor Inspection. Starting in 1922, the Soviet government introduced scientific standards limiting concentrations of toxic substances in the air of industrial establishments. The standards established stimulated the application of analytical chemistry in work on labor protection and industrial safety procedures. The work on limiting concentrations of toxic gases, vapors, and dust in the working zone of industrial establishments has been reflected in the All-Union State Standards of Construction Planning (Designing), GOST [State All-Union Standards], and OST [All-Union Standard].

An extensive network of industrial sanitary chemistry laboratories has been created in the USSR. These laboratories function as component parts of scientific research institutes of labor protection of the All-Union Central Council of Trade Unions (VTsSPS), scientific research institutes of labor hygiene of the Ministry of Health, sanitary-epidemiological stations, and other institutions. These laboratories carry on a great number of investigations with the view to developing new and improving old methods for the determination of small concentrations of harmful substance.

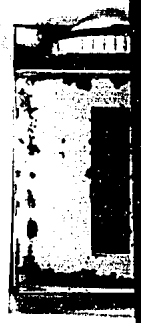
A distinguishing mark of the analytical procedures in this field is the low concentration of the substances which must be determined: the quantities that are subject to determination amount to thousandths or ten-thousandths of milligrams. Another distinguishing mark is the necessity of isolating these small quantities from the air under analysis. The solution of the problems involved in the analytical methods in question requires the application of the latest achievements of [general] chemical and physicochemical analysis. The [general] analytical methods are in turn improved as a result of their application in labor protection work.

Photometric analysis is used to an increasing extent in this field, because it is best suited for the determination of harmful substances present in low concentrations.

Polarographic analysis also occupies a significant place in determining small quantities of harmful substances. This method permits the separation of mixtures and analysis of ingredients of these mixtures.

Work has been done on the development of rapid methods for the analysis of the air of industrial establishments. These methods are based on highly sensitive reactions which make it possible to operate with small volumes of air. An example is the apparatus developed by the Leningrad Institute of Labor Protection of the All-Union Central Council of Trade Unions. This apparatus operates on the principle of linear colorimetric analysis: the air is drawn through an indicator tube filled with a powder that reacts with the substance being determined. Procedures for rapid determination of hydrogen sulfide, ammonia, chlorine, gasoline, benzene, and oxides of nitrogen have been developed on the basis of this principle.

Considerable work has been done in analytical chemistry in connection with the problem of preventing silicosis. New and original methods for determining quartz in the presence of silicates have been developed in that connection.



The second edition of the book entitled Opredeleniye Vrednykh Veshchestv v Vozdukhe Proizvodstvennykh Predpiyatiy (Determination of Toxic Substances in the Air of Industrial Establishments), Goskhimizdat, 1954, written by M. V. Alekseyeva, B. Ye. Andronov, S. S. Gurvits, and A. S. Zhitkova, as well as other publications, cite methods which make it possible to determine, with sufficient accuracy and reliability, small quantities of toxic substances that may be harmful to workers.

Significant progress in improving working conditions from this standpoint has been achieved by using gas analyzers. Equipped with signal devices, some of these analyzers emit a warning signal when the limiting concentration of the harmful substances has been reached. The Leningrad Institute of Labor Protection and the Makeyevskiy Scientific Research Institute of the Ministry of the Coal Industry are doing useful work in developing appliances important in the determination of harmful substances present in concentrations that may be dangerous from the standpoint of toxic effects or the possibility that a fire or explosion may occur. At these institutes, gas analyzers are being developed and perfected. These analyzers are to be used for the determination of carbon monoxide, continuous determination of methane in the air of mines, the determination of concentrations of ethyl gasoline and ordinary gasoline which may present a danger of explosion, etc. Work on the design of installations for the determination of various toxic substances in the air is also being done. Automatic gas analyzers for industrial use have been designed and are being manufactured.

Some important gaps in the application of analytical chemistry for purposes of labor protection and industrial hygiene still remain. A number of methods for determining small quantities of harmful substances are still too cumbersome and lack the requisite sensitivity and specificity. The work on the development of procedures for determining new substances used in modern technology must be regarded as inadequate.

Appliances for automatic analysis, photometric analysis, rapid analysis, and other types of analysis often do not go beyond the laboratories which have developed them. Work on them has either not been completed, or they are not introduced because an organization for the centralized production of appliances of this type is lacking. It would be of great advantage to equip all laboratories of the existing, very extensive network with newly developed appliances, so that a thorough study of the possibilities of improving labor hygiene can be carried out.

Work on the prevention of the contamination of air with harmful gases, vapors, and dust is not carried out on an adequate scale. The most serious lag exists in the prevention of silicosis in mines.

The development of the national economy entails the creation of new types of industrial production in connection with which new problems arise that must be solved by labor protection laboratories and institutes. The personnel of plant laboratories can help in this task by designing technological processes accordingly. Adequate contacts with labor protection laboratories must be established for this purpose.

It is time to get rid of the outlived notion that industrial injuries to health are unavoidable. (2)

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SOURCES

1. F. D. Krivoruchko, "A Conference on Problems of Industrial Sanitary Chemistry," Gigiyena i Sanitariya, Moscow, No 3, 1955, pp 55-6

2. "Analytical Chemistry in the Service of Labor Protection," (Editorial), Zavodskaya Laboratoriya, Vol 21, Moscow, No 3, 1955, pp 259-60

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